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Electric-powered wheelchairs as an assistive technology

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This paper briefly outlines recent work done, particularly in control systems, for electric powered wheelchairs. These mobility aids, first developed in the 1950's [1], were improved with the incorporation of microprocessors. The requirement for mobility aids in general is rising; for example, it is reckoned that 1.5% of the U.K. population require such aids. As an assistive technology, electric powered wheelchairs have many benefits. Nevertheless, a reliable and robust such wheelchair has still to evolve; for example, each year approximately 350 wheelchair users are injured due to tipping of the wheelchair [2]. Wheelchairs may be used in indoor applications only (Figure 1), outdoors applications only (Figure 2) or in both indoor and outdoor applications (Figure 3); all figures are from <http://www.teftec.com/gallery.asp>.



Figure 1



Figure 2



Figure 3

A variety of wheelchair stability standards exist. In Europe, CEN 12183 and CEN 12184 deal with manual and electric wheelchairs, respectively. Another standard is ISO-7176, which has sections dealing with wheelchair static and dynamic stability, for example. From a control point of view, requirements are wheelchair velocity control, traction control, suspension control, stability control and wheelchair navigation (including automatic obstacle avoidance to enhance autonomy). A full discussion of the structure of an electric wheelchair control system is given by [1], together with electric wheelchair models and manufacturer information.

At Dublin Institute of Technology, research into rehabilitation and assistive technologies has been a major focus for twenty years. Dr. Eugene Coyle of the School of Electrical Engineering Systems received his Ph.D. on the design and control of electric powered wheelchairs and he has supervised numerous projects at undergraduate and postgraduate level on the topic. A recent successfully completed project has involved the implementation of a controlled braking scheme for a wheeled walking aid [3]. The school has recently set up a dedicated biomedical engineering, assistive technology and health informatics research group which is committed to excellence in research, scholarship and entrepreneurship, supporting innovation and commercialisation of new ideas. Further information is available at the school website (<http://eleceng.dit.ie/>).

In conclusion, an automatically controlled electric power wheelchair is a very useful tool for people with special needs who require a mobility aid. Significant effort is being expended in the development of computer controlled electric wheelchairs with sensors and intelligent control algorithms to minimise human intervention (e.g. [4]). There remain challenging design and control problems to make electric wheelchairs reliable and robust, at an affordable price and with multiple useful features.

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